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ART. XII.—*Australian Termites (Isoptera). Biological Notes and Descriptions of New Species.*

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This paper contains notes on the biology, distribution and synonymy of several species of Australian *Calotermes*, *Coptotermes*, *Heterotermes*, and *Eutermes*, which have come under notice recently. Two species of *Calotermes*, one species of *Heterotermes*, and one species of *Eutermes* are described as new, and a new name is proposed for *Coptotermes flavus* Hill.

Genus **Calotermes**.

CALOTERMES (CALOTERMES) OLDFIELDI Hill.

*Proc. Roy. Soc. Vic.* (n.s.), xxxvii., p. 207, 1925.

This species, described originally from Kiata, Mallee District, Victoria, has been taken more recently on Kangaroo Island, South Australia (Miss W. Hughes), where alates, soldiers and larvae were found on 29th November and alates (at lamp) on 31st January.

CALOTERMES (CALOTERMES) OLDFIELDI var. CHRYSSEUS Hill.

*Proc. Roy. Soc. Vic.* (n.s.), xxxviii., p. 201, 1926.

This termite is very variable in the size of the head, eyes and pronotum of the imago and in the size and colour of the soldier. The antennae of the former have from 16-20 segments and those of the latter 10-15 segments.

Additional localities.—New South Wales: Bungendore and Galston; Federal Capital Territory: various localities at elevations of from 2,300-4,000 feet.

Biology.—The normal habitus of this species is in branch stubs and adjacent truewood of living Eucalyptus trees at heights of from a few feet to 140 feet from the ground; it occurs also in the branches and trunks of dead trees. In the former positions it is often associated with other species, e.g., one soldier with a king, queen and larvae of *Calotermes rufinotum* in branch stub 140 feet from the ground; a queen and many nymphs with a queen of *Calotermes rufinotum* in a branch stub 75 feet from the ground; soldiers, nymphs and larvae with a soldier and

nymphs of ?*Calotermes spoliator*, n. sp.; a queen with king, queen and larvae of *Calotermes tillyardi*, n. sp., in a branch stub 76 feet from the ground; two kings, two queens, one soldier and four larvae with a king, queen and one larva of *Calotermes (N.) insularis* (White).

The winged form, which flies by night, has been taken from 29th of November to 8th February.

CALOTERMES (NEOTERMES) INSULARIS (White).

Walker, Cat. Neurop. Ins. Brit. Mus. (3), 1853.

*Calotermes longiceps* Froggatt.

Proc. Linn. Soc. N.S.W., xxi., p. 528, 1896.

*Calotermes robustus* Froggatt.

Proc. Linn. Soc. N.S.W., xxi., p. 529, 1896.

?*Calotermes (Neotermes) deuqueti* Hill.

Proc. Roy. Soc. Vic. (n.s.), xxxviii., p. 196, 1926.

In a previous paper the writer<sup>(4)</sup> suggested that *C. longiceps* Frogg. is synonymous with *C. insularis* (White). Since then many complete series from New South Wales and the Federal Capital Territory have been compared with Froggatt's type (soldier) and with Victorian specimens, with the result that this synonymy has been established. Further, two alates from Froggatt's collection, labelled by him "*Calotermes longiceps*, Sydney, in logs" are also referable to White's species, as is the unique type (imago) of *Calotermes robustus* Froggatt and the soldier associated with it by Froggatt<sup>(5)</sup>. *Calotermes (N.) deuqueti* also is probably referable to *C. insularis*. Alates from the same colony often differ markedly from each other in colour and in the size of the head, eyes, ocelli and pronotum.

Additional localities.—New South Wales: Galston, Mona Vale, Collaroy; Victoria: Orbost; Federal Capital Territory: various localities at elevations of from 2,100–2,600 feet.

The paucity of material in the older collections has conveyed the impression that *C. insularis* is an uncommon species, which is by no means the case. The explanation of its apparent rarity is probably to be found in the fact that its normal habitus is not in logs and stumps, the situations in which it has generally been found, but in large living trees of various species of Eucalyptus, which few entomologists have an opportunity of examining closely.

Biology.—This is the largest species found in South-eastern Australia and one which is responsible for very considerable damage to living Eucalyptus trees. The attack appears always to begin by the foundation of a colony in a branch stub or fire scar at heights varying from a few feet to upwards of 100 feet from the ground, whence galleries are excavated in the sapwood

and truewood upwards into the secondary branches and downward into the butt and even into the roots. In the Federal Capital Territory it causes great damage at lower elevations, but it has not been found at elevations of from 3,500–4,000 feet, at which small Ash forests occur. There is good reason to believe that it is one of the species which cause enormous losses in the commercial forests of Victoria.

The winged form, which has been taken from 13th February to 21st May, possesses considerable powers of flight, thus differing markedly from the mound-building and subterranean *Rhinotermitidae* and *Termitidae*.

*CALOTERMES* (subgen. ?) *RUFINOTUM* Hill.

*Proc. Roy. Soc. Vic.* (n.s.), xxvii., p. 207, 1925.

This species occurs commonly in the Federal Capital Territory in branch stubs and adjacent truewood of several species of *Eucalyptus* trees.

Additional localities.—New South Wales: Eden; Federal Capital Territory: Brindabella Range, at elevations of from 2,600–4,100 feet.

Biology.—The habits of this termite are very similar to those of the previously mentioned species, with which it sometimes associates, as already noted. It has been found in association also with *Calotermes tillyardi*, n. sp., as follows:—Soldiers and ? larvae with soldiers and larvae; queen and larvae with soldier; and king, queen and ? larvae with two kings, two queens and ? nymphs. In several instances incipient colonies of *C. rufinotum* have been found to comprise two or more kings and queens and a few larvae. Apart from the presence of two or even three species in the same system of galleries the occurrence of additional species in other parts of the tree has been noted frequently. *Porotermes adamsoni* (Frogg.) and *Coptotermes frenchi* (nom. nov. for *C. flavus* Hill nec Bugnion and Popoff) are commonly to be found in the heart and truewood of trees attacked elsewhere by some or all of the above-mentioned species of *Calotermes*.

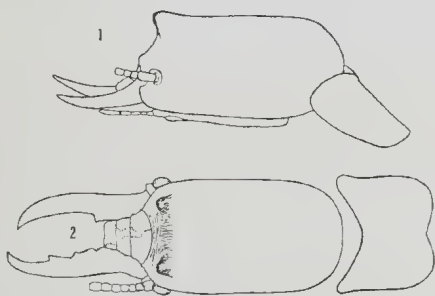
*CALOTERMES* (subgen. ?) *SPOLIATOR*, n. sp.

(Figures 1 and 2.)

*Soldier.*

Colour.—Head orange-rufous behind, shading to dark ferruginous and thence to black anteriorly; proximal fourth of mandibles dark ferruginous, anterior three-fourth black; labrum, antennae, palpi and pronotum orange-rufous; gula dark orange-rufous shading to dark ferruginous or blackish anteriorly; legs and dorsal sclerites of abdomen a little lighter than pronotum.

Head (Figs. 1 and 2).—Long and narrow, parallel on the sides to the antennal carinae, where it is slightly narrower; with very few hairs; antennal carinae very large and markedly projecting; frons sloping sharply to the clypeus; anterodorsal margin with two large prominences. Post- and ante-clypeus short, truncate in front, the former with a fringe of hairs. Labrum large, nearly twice as wide as long, wide at the base, narrowed anteriorly to the broadly truncate apex, with a fringe of five or six hairs near the apex and two pairs posteriorly to these. Antennae short and stout, with from 11 to 14 segments; the 1st short and stout, twice as long as the 2nd; 2nd quadrate; 3rd, 4th and 5th subequal, as wide as 2nd, or 3rd shorter and narrower than 4th and 5th, or 3rd and 4th subequal, smaller than 5th; the following segments, excepting the last, longer than the preceding ones; the apical segment short and narrow. Eyes moderately large, elongate oval, oblique, widely separated from the posterior margin of the antennal carinae. Mandibles very long and slender, parallel with the axis of the head when



FIGS. 1 AND 2.

1. *Calotermes spoliator*, n. sp. soldier: head and basal segments of antennae, lateral view.
2. *Calotermes spoliator*, n. sp. soldier: head and basal segments of antennae, dorsal view.

viewed laterally; the right with two short stout triangular teeth in the proximal half, the anterior half very narrow and parallel-sided to near the apex, the left with two broad teeth in the proximal half and a somewhat smaller angular one in the distal third.

Thorax.—Pronotum as wide as head, with few hairs, the anterior margin bent up, the sides nearly parallel and markedly arched, the anterior margin deeply and widely notched in the middle, the posterior margin wide and less deeply notched than the anterior margin. Meso- and metanotum with short wing rudiments.

Legs.—Short and stout, with scanty short hairs; claws and tibial spurs very short and stout; tibial spurs 3: 3: 3.

| Measurements.                               |         | mm.       |
|---|---------|-----------|
| Total length                                | .. .. . | 5.20-7.00 |
| Head, base to apex of mandibles, long       | .. .. . | 2.40-2.88 |
| Head, base to clypeofrontal suture, long    | .. .. . | 1.80-1.92 |
| Head, wide                                  | .. .. . | 0.99-1.11 |
| Gula, at narrowest part, wide               | .. .. . | 0.20-0.26 |
| Mandibles, from external articulation, long | .. .. . | 1.07-1.18 |
| Antennae, long                              | .. .. . | 1.11      |
| Pronotum, long 0.44-0.59; wide              | .. .. . | 0.88-1.11 |
| Tibia iii., long                            | .. .. . | 0.66-0.74 |

Localities.—Federal Capital Territory: Uriarra (Type locality) and Black Mountain at elevations of about 2,400 feet; New South Wales: Galston, Kuring-gai Chase.

Biology.—The habits of this termite are very similar to those of the previously mentioned species in that it is generally found in branch stubs and adjacent truewood of species of Eucalyptus trees and very often in association with other species of termites. Soldiers only, or soldiers, larvae and nymphs, have been taken in association with soldiers, nymphs and larvae of *Calotermes* (*C.*) *oldfieldi* var. *chryseus* on two occasions, once with alates, nymphs and larvae of *Calotermes tillyardi*, n. sp., and once in very close proximity to, if not in association with, a complex comprising alates of *Calotermes* (*G.*) *eucalypti* Frogg., soldiers of *Calotermes* (*G.*) *tuberculatus* Frogg., and unidentified larvae in a tree which was infested also with *Coptotermes acinaciformis* (Frogg.) and *Heterotermes ferox* (Frogg.). On another occasion three soldiers were found with, or very close to, a complex comprising alates of *Calotermes tillyardi*, n. sp., soldiers of *Calotermes* (*G.*) *tuberculatus* Frogg., and larvae of *Poro-termes adamsoni* (Frogg.).

Affinities.—The imago is unknown, hence the impossibility of determining the subgenus to which this species belongs. The soldier is strikingly distinct from any known Australian species and does not appear to fall into any of the established subgenera.

Type.—In the collection of the Division of Economic Entomology, C.S.I.R., Canberra.

CALOTERMES (subgen. ?) TILLYARDI, n. sp.

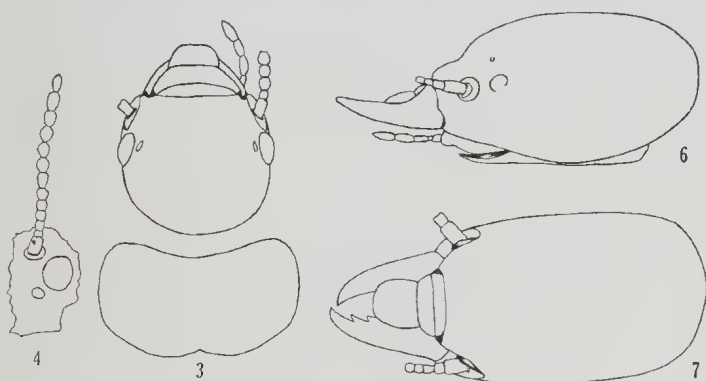
(Figures 3-8.)

*Imago.*

(Figures 3-5.)

Colour.—Head, thorax, palpi, abdomen, legs, and wing veins dark brown; clypeus whitish; labrum and antennae buckthorn-brown; wing membrane dark brown, lighter than veins.

Head (Fig. 3).—Small, widest midway between the eyes and the posterior margin, narrowed anteriorly; clothed scantily with minute hairs. Eyes small, not very prominent, variable in size and shape, circular (0.222–0.259 diam.), or subtriangular (0.185 x 0.222 diam.). Ocelli small, nearly circular (0.074 long diam.), less than their length from the margin of the eyes. Antennae (Fig. 4) with 13–15 segments, usually with 13, rarely with 15 segments, the 1st segment short and stout; 2nd about half as long as, and much narrower than, 1st, more or less quadrate; 3rd globose, longer and wider than 2nd, or 2nd and 3rd subequal, the latter narrowed at the base; 4th generally a little shorter and more rounded than 3rd, 3rd to penultimate segments



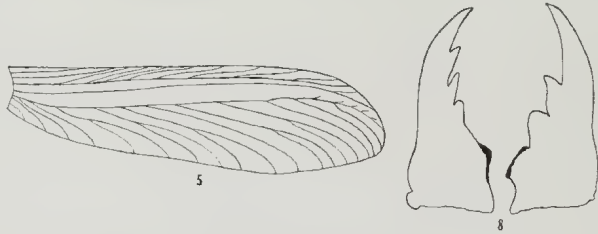
FIGS. 3, 4, 6, AND 7.

3. *Calotermes tillyardi*, n. sp. imago: head and basal segments of antennae and pronotum.
4. *Calotermes tillyardi*, n. sp. imago: antenna, showing relative position of eye and ocellus.
6. *Calotermes tillyardi*, n. sp. soldier: head and basal segments of antennae, lateral view.
7. *Calotermes tillyardi*, n. sp. soldier: head and basal segments of antennae, dorsal view.

increasing very slightly in size progressively; the last segment shorter and narrower than those near it, nearly parallel on the sides, bluntly rounded at the apex. Labrum short, wider than long, nearly parallel on the sides and nearly truncate in front.

Thorax.—Pronotum very large, much wider than head, more than twice as wide as long, markedly arched dorsally, the anterior margin broadly concave, the anterolateral corners slightly rounded, the sides nearly parallel, very little swollen, the posterolateral corners cut off obliquely, the posterior margin with wide and shallow notch. Posterior margin of the meso- and metanotum wide and slightly sinuate. Stumps of forewings very large, more than twice as long as those of the hind wings.

Wings (Fig. 5).—Short and moderately wide, the venation extremely variable. Subcosta and radius of the forewing short, the latter rarely branched; the radial sector with from nine to twelve or more branches to the costa, the distal branches sometimes forked; the media generally heavily chitinized, like the veins preceding it, and situated a little nearer to the former than to the latter, rarely midway between the radial sector and the cubitus, unbranched or with many branches distally; often joins the radial sector near the apex of the wing, where it may form a succession of loops with the latter vein. The cubitus generally passes through the middle of the proximal one-third of the wing, thence through the anterior one-third and joins the margin above or below the apex. This vein and its numerous branches nearly always occupy the greater part of the wing area. In the head wing the subcosta does not extend beyond the suture; the radius is short, as in the forewing; the radial sector has from five to nine branches to the costa; the media branches from the radial sector well beyond the suture (not near the base of



FIGS. 5 AND 8.

5. *Calotermes tillyardi*, n. sp. fore-wing.

8. *Calotermes tillyardi*, n. sp. soldier: mandibles.

the stump as in the forewing) and passes midway between the radial sector and the cubitus, or nearer to the former than to the latter, to the apex of the wing. It is rarely branched, but often has short stout cross veins to the radial sector. The cubitus is generally similar to that of the forewing. The entire membrane and all the veins are dotted with scale-like micrasters.

Legs.—Short and stout, with few hairs, femora markedly thickened; tibial spurs 3:3:3, without serrations.

## Measurements.

|   | mm.        |
|---|------------|
| Length with wings .. .. .                   | 9.00-10.00 |
| Length without wings .. .. .                | 6.25- 6.50 |
| Head, base to apex of labrum, long .. .. .  | 1.14- 1.22 |
| Head, to clypeofrontal suture, long .. .. . | 0.77- 0.88 |
| Head, at and including eyes, wide .. .. .   | 0.85- 1.03 |
| Antennae, long .. .. .                      | 1.40       |
| Pronotum, long 0.51-0.74; wide .. .. .      | 0.88- 1.29 |
| Forewings, long 5.75-6.00; wide .. .. .     | 1.66- 1.80 |
| Tibia iii., long .. .. .                    | 0.74       |

## Soldier.

(Figures 5-8.)

The identity of the soldier of this species has not been established beyond doubt, owing to the fact that more than one species of this caste has been found to consort with the imagos at present available for examination. For the purpose of recording the results of investigations that are now being made into the causes of the destruction of commercial forest trees the naming of hitherto undescribed species cannot be deferred indefinitely. From a study of the material at hand one is reasonably satisfied with the selection of the form described below as the soldier of *C. tillyardi*; it is possible, however, that the acquisition of further series may necessitate the designation of another as the sterile caste of the species under notice.

Colour.—Head pale orange-yellow behind, shading to dark ferruginous in front; antennae, pronotum and dorsum of abdomen as in base of head.

Head (Figs. 6 and 7).—Long and narrow, less than half as wide as long, the sides almost parallel to the base of the mandibles, the posterior margin broadly rounded, sutures distinct, frons sloping at an angle of about  $45^\circ$ . Eyes large, hyaline. Ocelli very small and widely separated from the eyes. Gula long and narrow. Antennae short and stout, of 11 or 12 segments; 1st segment short and wide; 2nd about half as long and two-thirds as wide as 1st; 3rd and 4th very variable; the following segments, excepting the last, short and wide, becoming progressively longer, the apical segment shorter and narrower than the next. Labrum short and wide, truncate in front. Mandibles (Fig. 8) short and stout; the left with three angular forwardly directed teeth, the right with two large teeth, the anteriormost far from the tip of the mandible.

Thorax.—Pronotum with very few hairs, moderately flat, concave in front, broadly rounded on the sides and behind, the posterior margin slightly sinuate. Posterior margin of meso- and metanotum truncate, with short wing-rudiments.

Legs.—Short and stout; tibial spurs 3:3:3.

| Measurements.                         |         | mm.       |
|---------------------------------------|---------|-----------|
| Total length                          | .. .. . | 4.50-6.00 |
| Head, base to apex of mandibles, long | .. .. . | 1.96-2.44 |
| Head, wide                            | .. .. . | 0.92-1.11 |
| Gula, at narrowest part, wide         | .. .. . | 0.20-0.25 |
| Pronotum, long 0.48-0.62; wide        | .. .. . | 0.81-1.07 |
| Tibia iii., long                      | .. .. . | 0.59-0.77 |

Localities.—Federal Capital Territory (type locality): at elevations from 2,100-4,100 feet; New South Wales: Galston.



Biology.—As with the preceding species, this termite is generally found in branch stubs and adjacent truewood of species of *Eucalyptus* trees. Its association with other species has been noted in the preceding pages. The winged form occurs from the beginning of December to the end of March.

Affinities.—The alate form is readily distinguished from all previously described species by its colour and wing venation. The latter approaches that of the subgenus *Neotermes* and agrees closely with that of *Calotermes rufinotum* Hill and *Calotermes obscurus* Walker, which, however, are not *Neotermes*. The soldier closely resembles that of *Calotermes rufinotum* and *Calotermes (G.) eucalypti* Frogg., both of which have relatively longer and narrower heads and narrower gula.

Types.—In the collection of the Division of Economic Entomology, C.S.I.R., Canberra.

### Genus **Coptotermes**.

COPTOTERMES LACTEUS (Froggatt).

*Ag. Gaz. N.S.W.*, viii., p. 297, 1897.

*Coptotermes sedulus* Hill.

*Proc. Linn. Soc. N.S.W.*, xlvii., p. 40, 1923.

The examination of many complete series collected recently in various localities near Melbourne, throughout Gippsland, south-eastern New South Wales and the Federal Capital Territory leaves little doubt but that *C. sedulus* is synonymous with Froggatt's species.

COPTOTERMES FRENCHI, NOV. NOM.

*Coptotermes flavus* Hill,  *nec* Bugnion and Popoff.

*Proc. Roy. Soc. Vic. (n.s.)*, xxxviii., p. 207, 1926.

The name given originally to this species has been used previously<sup>(1)</sup> for a Ceylon species; it is proposed, therefore, to rename it in honour of Mr. Chas. French, Jun., Government Entomologist of Victoria.

It occurs commonly in the Federal Capital Territory, where it does considerable damage to living *Eucalyptus* trees. There are no records to indicate that it ever builds mounds in any of the localities in which it is known.

Additional localities.—New South Wales: Galston and Eden; Victoria: Craigieburn; Federal Capital Territory: various localities at elevations of from 2,100 feet to 2,600 feet.

## ? COPTOTERMES AUSTRALIS (Walker).

*Cat. Neurop. Ins. Brit. Mus.*, iii., p. 525, 1853 (Termes).

This species remains unrecognized in recent Australian collections, but it is of interest to note that a wing identified many years ago by Froggatt as *Termes australis* Walker is that of a pale-winged species of *Coptotermes*.

Genus **Heterotermes**.

HETEROTERMES PLATYCEPHALUS Froggatt.

*Proc. Linn. Soc. N.S.W.*, xxi., p. 551, 1896.

*Leucotermes clarki* Hill.

*Bull. Ent. Res.*, xxi., p. 395, 1922; *Mem. Nat. Mus., Melbourne*, No. 7, p. 45, 1927.

Since the publication of the writer's revision of the genus<sup>(4)</sup> a wing from the type and a complete series from the type locality (Kangaroo Island, South Australia) have become available for examination, with the result that it can be stated definitely that *Heterotermes* Froggatt, 1896, replaces *Leucotermes* Silvestri, 1901, and that *Leucotermes clarki* Hill is synonymous with *Heterotermes platycephalus* Frogg. *Psalidotermes* Silvestri, 1909, also, is synonymous with *Heterotermes*,<sup>(7)</sup> to which genus should be referred all the species listed by the writer<sup>(9)</sup> under *Leucotermes*. No changes in specific names are involved.

Additional localities.—South Australia: American River, Kangaroo Island (all castes, 29th November); Western Australia: Barronhurst, Mt. Barker, Wuraming (in Jarrah log), Pemberton (queen, soldiers and workers in mound of *Hamitermes obeuntis* Silv.), Manjimup (under log), Armadale (in "white gum" stump), Fairbridge Experimental Farm (in "marri" stump, with *Hamitermes obeuntis* Silv.), Kirup Siding and Greenbushes (in mound of *Hamitermes obeuntis* Silv.).

## HETEROTERMES FEROX Froggatt.

*Proc. Linn. Soc. N.S.W.*, xxii., p. 724, 1897 (*Termes*).

*Leucotermes occiduus* Hill.

*Mem. Nat. Mus. Melbourne*, No. 7, p. 50, 1927.

The above synonymy has been established as a result of the examination of numerous complete series from New South Wales, Federal Capital Territory, Victoria, and Western Australia.

Additional localities.—New South Wales: Captain's Flat, Appin, Leura (at 3,200 feet), Uralla, Mittagong, Galston, Brookvale, French's Forest, and Nowra; Federal Capital Territory: various localities at elevations of from 2,100 to 2,600 feet; Victoria: Ouyen, Kiata, Mildura, Linga, Kewell, Warrandyte, and Melton; Western Australia: Growangerup, Watheroo, Mullewa, Wickepin, and Yilgan.

Biology.—This species is found in small colonies under stones and logs, and occasionally in the mounds of other species of termites and ants (*Iridomyrmex detectus*), as well as in dead trees. It is often very destructive to imported soft-woods, but does little damage to local hardwoods. The winged form has been taken from 25th October (in New South Wales) to 27th May (in Western Australia).

HETEROTERMES VENUSTUS (Hill).

*Mem. Nat. Mus. Melbourne*, No. 7, p. 55, 1927 (*Leucotermes*).

This species was described from a complete series collected at Stapleton, Northern Territory, on 4th November, 1914. A variety, or very closely allied species, represented by a complete series from Wyndham, W.A. (2nd December, 1930), differs from the type series in its slightly smaller size and distinctly small ocelli. In the description of *Heterotermes venustus* it is stated that ocelli are absent, whereas in a few examples they are present, as in the Wyndham material.

HETEROTERMES INTERMEDIUS, n. sp.

(Figures 9–12.)

*Imago*.

(Figures 9–11.)

Colour.—Head, pronotum and dorsum of abdomen dresden-brown; remainder of body, legs and antennae clay colour; wings buffy-brown, costal margin as in head.

Head (Fig. 9).—Moderately hairy, longer than wide, widest before the eyes, narrowed posteriorly. Postclypeus small (0.18 long x 0.44 wide), strongly convex, divided by a distinct suture, with three long hairs on either side of the mid-line, two being near the anterior margin and one in the middle. Eyes very small, sub-triangular (0.185 max. diam.), not projecting beyond the lateral margin of the head, widely separated from lower lateral margin. Ocelli present, very small, in contact with the eyes. Labrum large, bluntly rounded in front, strongly inflated on the sides, markedly convex. Fontanelle very small but distinct, midway between the clypeofrontal suture and posterior

margin of the head. Antennae (Fig. 10) with 17 segments; the 1st segment long and nearly cylindrical, twice as long and a little wider than 2nd; 2nd slightly widened at apex, longer than wide; 3rd half as long and markedly narrower than 2nd; 4th, 5th, and 6th as wide as 2nd, globose; 7th to 15th elongate, increasing in length progressively; 16th as long as 15th; 17th elongate oval, a little shorter than the 15th and 16th.

Thorax (Fig. 11).—Pronotum of typical form, narrower than head, the anterior margin slightly elevated and convex and with distinct median notch, anterolateral angles rounded, sides sloping in sharply to the sinuate posterior margin; hairs moderately large and dense. Meso- and metathorax wide in front, narrowed sharply to the deeply notched and narrow posterior margin, the notch in metanotum always less than in mesonotum.

Wings.—Long and slender, the radius, radial sector, proximal branches of the cubitus and the extreme proximal end of the media distinct.

Legs.—Moderately slender, short, with scanty hairs; tibial spurs long and slender, 3:2:2.

Abdomen.—Long, narrow, and moderately hairy. Cerci with basal segment short and very wide. Styli (males only) slender.

| Measurements.                                    | mm.         |
|--|-------------|
| Length with wings .. .. .                        | 10.00–10.50 |
| Length without wings .. .. .                     | 4.75– 5.25  |
| Head, base to apex of labrum, long .. .. .       | 1.25– 1.29  |
| Head base to fontanelle, long .. .. .            | 0.37        |
| Head, base to clypeofrontal suture, long .. .. . | 0.74        |
| Head, wide 0.83–0.85, narrowed to .. .. .        | 0.77– 0.81  |
| Antennae, long .. .. .                           | 1.80        |
| Pronotum, long 0.48*; wide .. .. .               | 0.70        |
| Forewings, long 8.00; wide .. .. .               | 2.14        |
| Tibia iii., long .. .. .                         | 0.81– 0.85  |

\*Measured along midline, i.e., minimum length.

*Soldier.*

(Figure 12.)

Colour.—Head yellow, palest behind; mandibles ferruginous; labrum and antennae yellow, the latter darker than head; articulations of mandibles forming dark ferruginous spots at either end of the postclypeus; anterodorsal prominences of head suffused with dark brown; legs straw coloured; thorax and abdomen whitish.

Head (Fig. 12).—Long and narrow, nearly parallel on the sides. Mandibles long and moderately stout, of typical form. Labrum large, bluntly conical. Antennae of 16 or 17 segments.

| Measurements.                             |    |    |    |    | mm.       |
|---|----|----|----|----|-----------|
| Total length                              | .. | .. | .. | .. | 5.00      |
| Head, with mandibles, long                | .. | .. | .. | .. | 2.73-2.81 |
| Head, wide                                | .. | .. | .. | .. | 0.96-1.00 |
| Mandibles, left, entire                   | .. | .. | .. | .. | 1.11      |
| Mandibles, left, from basal tooth to apex | .. | .. | .. | .. | 0.96      |
| Gula, at narrowest part, wide             | .. | .. | .. | .. | 0.18      |
| Pronotum, long 0.38-0.48; wide            | .. | .. | .. | .. | 0.72-0.83 |
| Tibia iii., long                          | .. | .. | .. | .. | 0.85      |

*Worker.*

| Measurements.             |    |    |    |    |      |
|---------------------------|----|----|----|----|------|
| Total length              | .. | .. | .. | .. | 5.25 |
| Head, wide                | .. | .. | .. | .. | 0.96 |
| Pronotum, long 0.44; wide | .. | .. | .. | .. | 0.70 |

Locality.—Western Australia; near Kalgoorlie (A. G. Nicholls, 19th March, 1928).

Affinities.—The imago differs from *Heterotermes platycephalus* Frogg. in its markedly smaller size, darker and relatively longer and narrower head, the position of the ocelli and in the distinctly narrower and more deeply notched meso- and metanotum. The soldier differs in being smaller, and having the anterodorsal prominences of the head suffused with dark brown. From *Heterotermes validus* Hill the imago differs in having ocelli, considerably smaller head, eyes and pronotum, pronotum relatively shorter and narrower, more strongly convex postelypeus, and meso- and metanotum of different form (in *Heterotermes validus* these sclerites are broad and truncate, or only slightly sinuate, posteriorly), the total length is about the same in both species. The soldier of the proposed new species is distinctly smaller than that of *Heterotermes validus*, the head is narrower in proportion to width, and is not so markedly truncate in front and behind and the mandibles are more slender. In *Heterotermes paradoxus* (Frogg.) the ocelli, when present, are larger and well separated from the eyes, the eyes are larger and the posterior margin of the meso- and metanotum is either convex or very slightly sinuate, never deeply notched. The soldier of *Heterotermes paradoxus* has a larger and relatively narrower pronotum than *Heterotermes intermedius*.

Types.—In the collection of the Division of Economic Entomology, C.S.I.R., Canberra.

Genus **Eutermes**.

EUTERMES EXITIOSUS Hill.

*Proc. Roy. Soc. Vic.* (n.s.), xxvii. (2), p. 222, 1925.

This species is widely distributed and very abundant throughout southern Australia, and is without doubt one of the most destructive species to timber structures. Their low dome-shaped mounds, which are familiar objects wherever the species

occurs, rarely exceed 3 feet in height by about 2 ft. 6 in. in diameter at the base, and are composed of an intensely hard mass of earthy material and triturated wood generally covered externally with particles of earth or sand cemented together to form a more or less durable thin outer wall. The "nursery," which rests upon the ground about the middle of the mound, is composed of thin layers of brittle woody material moulded to form innumerable flattened cells and galleries connected with each other by small circular openings. The queen cell lies in the lower part of the "nursery," and appears to be permanently occupied only by the queen. In no instance has a king been found in the queen-cell or elsewhere in the mound, which appears to indicate that he dies at a comparatively early stage of the development of the colony. The feeding range of a colony has not been ascertained, but it is probably not less than 30 to 40 yards. The damage done by this termite to fence-posts, telephone poles, structural timber, &c., is usually clearly indicated by the presence of shelter-tubes on the external surfaces of the object attacked, but in the case of a wooden building considerable damage may result from attacks confined to the concealed bearers, and joists, and to the interior of floor-boards and wall-boards, access to which may be gained either by means of shelter-tubes built externally over the supporting brickwork or wood piers or piles or by galleries tunnelled in the latter. In two cases the main colony was traced to the fire-place, under which an extensive nest was found to have been constructed in wood debris. In other cases damage appeared to have resulted from attacks of foraging parties from a mound in the vicinity of the building.

This is the species identified by Froggatt<sup>(2)</sup> as *Eutermes fumipennis* Walker, as disclosed by an examination of a specimen so labelled (from Shoalhaven, N.S.W.) which is now in the C.S.I.R. Collection. Reasons for differing from Froggatt in this connexion have been stated previously by the writer.<sup>(3)</sup> The identity of the arboreal termite referred to by Froggatt has not been satisfactorily established; that certain arboreal *Eutermes* from near Sydney are specifically distinct from *E. exitiosus* is beyond doubt.

*E. exitiosus* appears to be a variable species both in the alate and in the soldier castes, but even with the large number of complete series now available for examination it has been found impossible to differentiate forms which might be regarded as varieties or subspecies.

The alate form has been taken from 11th October to 20th November.

Additional localities.—New South Wales: Dubbo, Prospect, Kuring-gai Chase, Hornsby, National Park, Appin, Nowra, Nerriga, Goulburn, Galston, Parramatta, Eden; Federal Capital

Territory: various localities at elevations from 2,100 to 2,500 feet; Western Australia: Armadale; South Australia: Kangaroo Island, Mt. Gambier; Victoria: Mallee District, ? Broadford.

*Correction.*

In the description the total length of the alate imago is stated to be from 25.00–26.50 mm.; this should read 17.00–17.50 mm.

EUTERMES FUMIGATUS Brauer.

*Reise der Novara, Zool. Theil, 2A., 1866.*

This species was described from specimens collected in Sydney. Well preserved cotypes are to be found in the collections of the C.S.I.R. and the writer. Froggatt records it from the type locality and from Newcastle and Colo Vale, N.S.W., his identifications being based on comparisons with cotypes. Mjöberg records it from Perth, Western Australia, and from Mt. Lofty, South Australia. He had specimens identified by Froggatt for comparison. The specimens examined by the writer include many complete and incomplete series from numerous localities in New South Wales and the Federal Capital Territory at elevations from 2,100 to 3,200 feet. Many of these series agree with the typical form described by Brauer; others show rather considerable variation in dimensions and colour in the alates, and colour of the head in soldiers. An attempt has been made to distinguish the more marked of these variants as subspecies or varieties, but this has been found unsatisfactory, and for the present, at any rate, it is proposed to regard Brauer's species as a variable one. A series comprising a queen, soldier and worker from Mt. Lofty (Adelaide Museum) appears to be referable to this species, but none of the extensive Western Australian collections examined include specimens very closely allied to it. *Eutermes dixonii*, n. sp., though clearly allied to the above, cannot be regarded as a variety, a conclusion arrived at independently by Dr. Emerson.

The form commonly found in the Federal Capital Territory differs from the cotypes and from typical series from Hornsby and Pillaga Scrub in that the alates are paler in colour and often have larger eyes, and the soldiers lack the brown suffusion on the sides and base of the head. The following description of examples from the F.C.T. is given for comparison with closely allied species which will be described subsequently in similar terms:—

*Imago.*

Colour.—Head, thorax and tergites of abdomen dark brown, paler than in *E. dixonii*, n. sp.; legs, elypeus and palpi orange-yellow; antennae brown; wings light brown; sternites of abdomen mostly yellow, one to six suffused laterally with light brown.

Head.—Densely clothed with long and short hairs. Fontanelle large and very distinct, elongate, narrowed posteriorly, expanded anteriorly. Postclypeus large, strongly convex above, a little shorter than half its width. Eyes very large (diam. 0.296–0.333) and prominent, very close (0.037) to lower lateral margin of head. Ocelli very large, broadly oval (0.074 x 0.110–0.120), 0.037 from the eyes. Antennae with 15 segments; 1st twice as long as 2nd; 2nd nearly cylindrical; 3rd very short and narrow, smallest of all; 4th globose, as long and as wide in the middle as 2nd; 5th globose, shorter and narrower than 4th and 6th; 6th very little longer than 4th; 7th to 14th elongate and becoming progressively longer.

Thorax.—Pronotum moderately densely clothed with mostly stout hairs, the anterolateral angles broadly rounded; side rounded to the slightly sinuate posterior margin; meso- and metanotum with posterior margin slightly sinuate, as in pronotum, or distinctly notched, clothed with scanty stout hairs.

Wings.—Wing stumps with scanty stout hairs, veins, excepting radial sector and proximal branches of cubitus, distinct.

Legs and Abdomen.—Clothed as in head.

| Measurements.                                    | mm.         |
|--|-------------|
| Length with wings .. .. .                        | 10.00–11.00 |
| Length without wings .. .. .                     | 5.00– 6.00  |
| Head, from base to apex of labrum, long ..       | 1.07– 1.18  |
| Head, from base to clypeofrontal suture, long .. | 0.66        |
| Head, wide .. .. .                               | 1.05        |
| Antennae, long .. .. .                           | 1.80– 1.90  |
| Pronotum, long 0.48; wide .. .. .                | 0.74– 0.81  |
| Forewings, long 8.50–9.50; wide .. .. .          | 2.40– 2.59  |
| Tibia iii., long .. .. .                         | 1.18        |

*Soldier.*

Colour.—Head light orange-yellow, rostrum ferruginous, antennae darker orange-yellow, palpi and tergite of abdomen paler, legs stramineous.

Head.—With very few hairs, rostrum long and moderately thick, more than one-third longer than the remainder of head, dorsum of head nearly straight in profile; outline of head (without rostrum) when viewed from above broadly oval; antennae inserted midway between base and apex of head, of 13 segments; 1st nearly cylindrical, one-third longer than 2nd; 2nd and 3rd almost equal in length and maximum width, 3rd narrower than 2nd at base; 4th about half the length of 3rd but nearly as wide; 5th to 12th elongate, of about equal length; 13th a little shorter than 12th.

In certain otherwise normal colonies there occur a small proportion of soldiers with short, curved snouts.



| Measurements.                            |       |      |    | mm.  |
|--|-------|------|----|------|
| Total length                             | ..    | ..   | .. | 3.50 |
| Head, from base to apex or rostrum, long | ..    | ..   | .. | 1.48 |
| Head, wide                               | ..    | ..   | .. | 0.88 |
| Antennae, long                           | ..    | ..   | .. | 1.36 |
| Pronotum, long                           | 0.18; | wide | .. | 0.44 |
| Tibia iii., long                         | ..    | ..   | .. | 0.85 |

*Worker.*

Head.—Sparsely clothed with reddish hairs, orange-yellow, posterior half suffused with light brown, clypeus and antennae light yellow, antennae of 14 segments, 4th shortest of all.

Biology.—This species does not build mounds, but it occurs commonly in the walls of mounds of *Coptotermes lacteus* (Frogg.), in which the complete life-cycle may be passed. Small colonies are to be found also under stones, logs, and in stumps and trunks of trees, in all of which situations the alate form may occur. Colonizing flights leave the parent nest at night during the period from 8th November to 11th December. There are no records of serious damage by this species to structural timber or living trees.

## EUTERMES DIXONI, n. sp.

(Figures 13–16.)

*Imago.*

(Figures 13 and 14.)

Colour.—Very dark brown; head, antennae, pronotum and tergites of abdomen darkest; behind the anterior margin of the pronotum a paler area about one-third the width of the sclerite and extending posteriorly in the middle; clypeus yellowish, suffused with brown, labrum and palpi of paler yellow; pleurites and sternites dark brown, lighter than head; tarsi yellow, tibiae and femora paler than pleurites; wings fuliginous, veins very dark.

Head (Fig. 13).—Densely clothed with mostly short hairs, hemispherical behind the eyes; fontanelle indistinct excepting in cleared preparations, linear, a little longer than, but only half as wide as ocelli; postclypeus about two-thirds wider than long, moderately convex above, slightly arcuate behind; eyes large (0.296–0.333 diam.) prominent, 0.045 from lower lateral margin of head; ocelli 0.110–0.120 long, broadly oval, about 0.045 from eyes; antennae with 15 segments, 1st about twice as long as 2nd and much wider; 2nd a little longer than wide, cylindrical; 3rd a little more than half as long as 2nd and very narrow, smallest of all; 4th to 6th globose, 4th nearly as wide as 1st, 5th shorter and narrower than 4th, 6th longer and wider than 4th; 7th to 14th becoming progressively longer, 15th as long as 14th but narrower.

Thorax.—Pronotum (Fig. 13) densely clothed with moderately long hairs, slightly sinuate in front, anterolateral angles broadly rounded, sides narrowed to the posterior border, which is wide and more or less distinctly emarginate; posterior margin of meso- and metanotum generally deeply emarginate.

Wings (Fig. 14).—Veins very dark and distinct to their extremities; membrane behind the radial sector suffused with deep yellow; median of the forewing without, or with from 2 to 7, branches; cubitus with ten or more branches, some of which may be forked; wing membrane densely hairy.

| Measurements.                                 |                   | mm.                |
|---|-------------------|--------------------|
| Length with wings                             | .. .. .           | 14.00-14.50        |
| Length without wings                          | .. .. .           | 5.50- 6.50         |
| Head, from base to apex of labrum, long       | .. .. .           | 1.40               |
| Head, from base to clypeofrontal suture, long | .. .. .           | 0.80- 0.88         |
| Head, at and including eyes, wide             | .. .. .           | 1.14- 1.22         |
| Antennae, long                                | .. .. .           | 1.92               |
| Pronotum, long                                | 0.55-0.59; wide   | .. .. . 0.88- 0.96 |
| Forewings, long                               | 11.50-12.00; wide | .. .. . 3.30- 3.75 |
| Tibia iii., long                              | .. .. .           | .. .. . 1.30- 1.48 |

*Queen.*

Total length, 21.00; width of abdomen, 5.00.

*Soldier.*

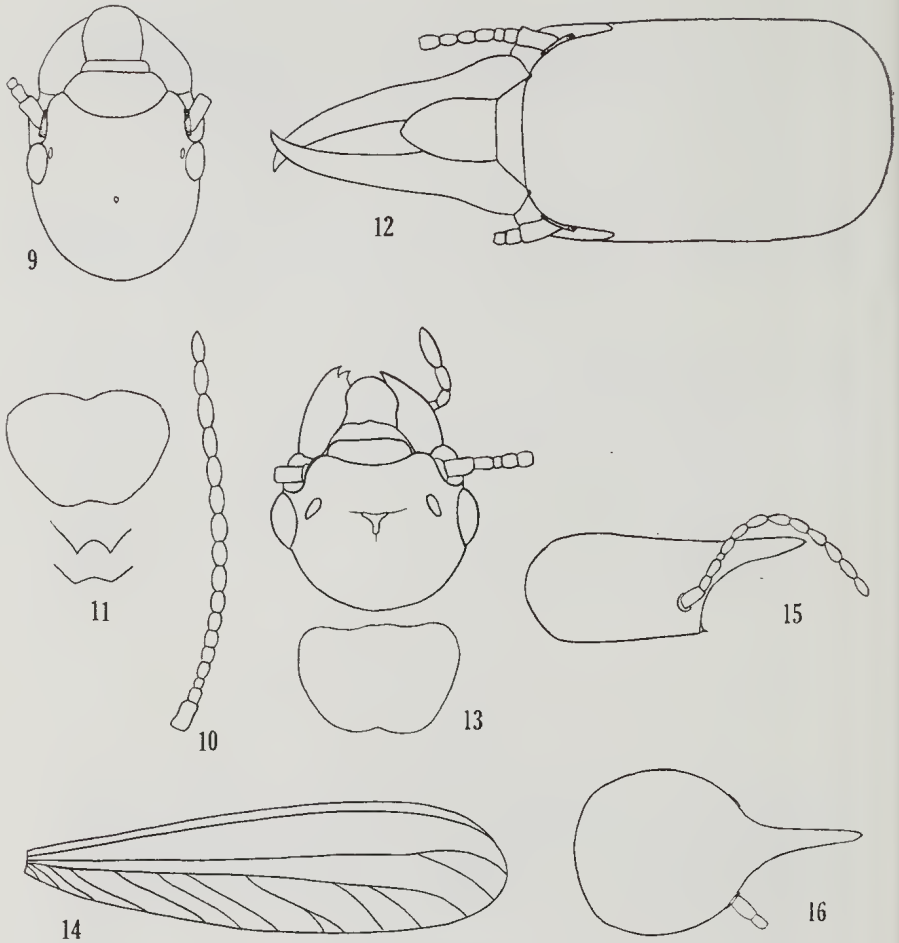
(Figures 15 and 16.)

Colour.—Head chamois-yellow, base lightest, richly suffused with brown on sides and above, snout ferruginous shading to deep orange-yellow at base; antennae same as base of snout; tergites of abdomen rather darker than base of head; legs stramineous.

Head (Figs. 15 and 16).—Snout long and moderately thick, about one-third the length of entire head, anterior two-thirds of dorsal surface nearly straight in profile, posterior one-third slightly inflated; posterior part from insertion of antennae circular when viewed from above; hairs very scanty. Antennae inserted midway between base of head and apex of snout, with 13 segments; 1st segment three-fifths longer and much wider than 2nd; 2nd about as long as 3rd, nearly cylindrical; 3rd swollen apically; 4th shortest and narrowest of all; 5th as long as 3rd but wider; 6th longer and wider than 5th; 6th-12th about equal in length; 13th as long as 10th, but narrower.

Thorax.—Of typical form; sparsely clothed with reddish hairs.

Abdomen.—Moderately densely clothed with long and short hairs.



FIGS. 9 TO 16.

9. *Heterotermes intermedius*, n. sp. imago: head and basal segments of antennae.
10. *Heterotermes intermedius*, n. sp. imago: antenna.
11. *Heterotermes intermedius*, n. sp. imago: pronotum and posterior margin of meso- and metanotum.
12. *Heterotermes intermedius*, n. sp. soldier: head and basal segments of antennae.
13. *Eutermes dixonii*, n. sp. imago: head and basal segments of antennae and pronotum.
14. *Eutermes dixonii*, n. sp. imago: fore-wing.
15. *Eutermes dixonii*, n. sp. soldier: head, lateral view.
16. *Eutermes dixonii*, n. sp. soldier: head and basal segments of antennae, dorsal view.

Legs.—Moderately stout; with fewer hairs than on abdomen.

|  | Measurements. | mm.       |
|--|---------------|-----------|
| Total length                             | .. .. .       | 3.50–3.70 |
| Head, from base to apex of rostrum, long | .. .. .       | 1.55–1.60 |
| Head, wide                               | .. .. .       | 0.99      |
| Antennae, long                           | .. .. .       | 1.40      |
| Pronotum, long 0.18–0.20; wide           | .. .. .       | 0.48–0.51 |
| Tibia iii., long                         | .. .. .       | 0.74      |

Abnormal soldiers have been found in association with others of the normal form in several colonies from the Federal Capital Territory; these have the rostrum shorter than usual and strongly bent downwards.

#### *Worker.*

Head.—Above mostly yellow, shading to light brown posteriorly, frontal and transverse sutures very distinct, sides and base mostly pale bluff, clypeus somewhat paler; antennae of 14 segments, light orange-yellow; thorax and abdomen yellowish; legs creamy white.

|   | Measurements. | mm.       |
|---|---------------|-----------|
| Total length                            | .. .. .       | 4.25      |
| Head, from base to apex of labrum, long | .. .. .       | 1.29      |
| Head, to clypeofrontal suture, long     | .. .. .       | 0.92      |
| Head, wide                              | .. .. .       | 1.11–1.14 |
| Pronotum, long 0.37; wide               | .. .. .       | 0.62–0.66 |
| Tibia iii., long                        | .. .. .       | 1.11      |

#### *Brachypterous (2nd form) reproductives.*

A portion of the rotten stump containing part of the type colony was removed to an even-temperature chamber on 25th March, 1930, where it was placed in a vertical position in a box of sandy soil with two-thirds of the timber exposed. When some of the wood near soil level was broken off on 19th June, 1930, it was found to contain about 80 brachypterous reproductives and numerous soldiers and workers. As only larvae, alate imagos, workers, and soldiers were present in the colony on 25th March, 1930, it is presumed that these neotenic forms were not more than 55 days old when discovered.

Description. — Head light brown; antennae, thorax and abdomen somewhat paler; fontanelle and head sutures very distinct; legs and palpi stramineous; ocelli well developed; eyes partly pigmented; thorax worker-like; wing buds of various lengths and stages of development even in the same individual; in extreme cases one bud greatly enlarged, the others vestigial.

There are many variations in size, colour, and degree of development, but the above is typical of the most advanced forms.

| Measurements.                       |       |      |    |    | mm.  |
|-------------------------------------|-------|------|----|----|------|
| Total length                        | ..    | ..   | .. | .. | 4.50 |
| Head, to apex of labrum, long       | ..    | ..   | .. | .. | 1.18 |
| Head, to clypeofrontal suture, long | ..    | ..   | .. | .. | 0.84 |
| Head, wide                          | ..    | ..   | .. | .. | 1.03 |
| Eyes, diam.                         | ..    | ..   | .. | .. | 0.15 |
| Pronotum, long                      | 0.37; | wide | .. | .. | 0.66 |

Localities.—Federal Capital Territory (type locality): various localities at elevations of from 2,100 to 3,500 feet; Victoria: Waratah Bay, Hurstbridge, Beaconsfield, Upper Berwick, Kilsyth, Healesville, Dartmoor, Mallacoota, Ferntree Gully, Cann River, Traralgon, Ararat (Mt. Langi Ghiran), Melbourne, Wilson's Promontory, Emerald, Leongatha, Taggerty.

Biology.—The habits of this species are generally similar to those of *Eutermes fumigatus* Brauer, excepting that it does not appear to inhabit the mounds of other species. The alate form has been taken from 11th December to 11th March.

Affinities.—The proposed new species is most closely allied to *Eutermes fumigatus* Brauer, from which it differs, *inter alia*, in the following details:—Imago: body and wings larger and darker; head always longer and wider; eyes generally larger; pronotum generally wider and longer and less markedly notched posteriorly; tibia iii. longer; soldier: head larger and distinctly darker in colour.

Types.—In the collection of the Division of Economic Entomology, C.S.I.R., Canberra.

This species has been named after Mr. J. E. Dixon, a veteran entomologist of Melbourne.

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